

Interim Progress Report  
NOAA's Sectoral Applications Research Program (SARP)  
Climate and Water Resource Management Project  
Drought-Related Proposals: Basin-Specific Drought Regional Decision Support

**Development of a Drought Decision Support Portal for the Republican River Basin  
of Colorado, Nebraska, and Kansas**

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## **I. Preliminary Materials**

### *A. Project Abstract:*

The United States does not currently have a comprehensive information system for drought monitoring and planning at the local level. However, efforts are underway to develop the National Integrated Drought Information System (NIDIS), which would be a web-based information portal that will provide drought information to decision-makers at a range of scales from local to national. One likely geographic scale that will be utilized to display information is the watershed level, but a prototype has not yet been developed that incorporates both drought monitoring and contextual management information required for holistic watershed-level planning.

One watershed that is especially in need of additional climate, drought monitoring, and management information is the Republican River Basin of Colorado, Nebraska, and Kansas. The citizens in this basin have faced water quality and quantity issues, several years of severe drought, and ongoing interstate litigation that is increasingly affecting the livelihoods of residents in the basin.

Unlike the country-wide conservation districts found in most states, Nebraska's natural resource districts (NRDs) are based on river basin boundaries, enabling them to approach natural resources management on a watershed basis. The Lower Republican NRD, Middle Republican NRD, and Upper Republican NRDs manage Nebraska's portion of the Republican River Basin. Through collaboration with NRD staff and stakeholders throughout the basin, this project proposes to develop a web-based drought decision support portal for the Republican River Basin. The intent of the portal is that it would serve the climate- and drought-related data and contextual informational needs of community officials, agricultural producers, and other water planners throughout the basin, and also serve as a prototype for a basin-level portal that could be incorporated into NIDIS in the future.

### *B. Objectives of Research Project*

This project proposes to develop a web-based drought decision support portal for the Republican River Basin of Colorado, Nebraska, and Kansas. Specifically, the National Drought Mitigation Center (NDMC) will work with NRD staff and stakeholders throughout the basin to identify and collect local drought monitoring and planning information needed by NRDs, local communities, and citizens within the basin. This research would include:

- An assessment of activities of government agencies in the basin regarding drought mitigation
- A synthesis of the present use of climate information (including data and forecasts) by stakeholders in the basin
- An accounting of gaps in information required by the basin's decision-makers in regard to drought and climate
- A formal report detailing recommendations for future opportunities and activities in terms of drought management and planning

- A web portal that will serve as a clearinghouse for this information, which will be housed on the websites of the Lower, Middle, and Upper Republican NRDs; other interested stakeholder agencies in the basin; and also as part of NIDS if eventually incorporated into the system.

The combination of climate and drought monitoring data and contextual planning information on the same website would create a more holistic resource for regional planners. Not only would the portal serve the immediate drought planning needs of the Republican River Basin but also serve as a model for developing local applications of NIDIS.

### *C. Project Approach*

#### 1. Consolidate and present existing climate and drought monitoring data

This research will investigate how climate and drought monitoring data can be portrayed at the watershed level, while still allowing the portal to be incorporated into NIDIS. NDMC researchers will work with local NRD staff and watershed stakeholders to identify and incorporate climate and drought monitoring data into an appropriate user interface. This interface will have to take into consideration needs of the website users, the requirements of a NIDIS portal, and the technical skill needed for local NRD staff to maintain the website over the long-term.

Many of geospatial data sets relevant for this project and the study location are now readily available in digital format on a wide variety of governmental and non-governmental websites. Although there is a great deal of information available, many studies have shown that it is often difficult for local decision-makers to locate, interpret, and incorporate climate and other drought monitoring information into decision-making (Easterling 1986; Hulme et al. 1992; Mjelde et al. 1998; Rayner et al. 1998; Austen et al. 2002; Ingram et al. 2002; Podesta et al. 2002; Jagtap et al. 2002; Changnon and Vonnahme 2003; Shohngen et al. 2003; Canales et al. 2005; Breuer et al. 2005; Knutson et al. 2006). Therefore, research will be undertaken on the best methods for presenting and describing the selected datasets to meet the needs of both local planners and a NIDIS web portal.

One team member, Mark Svoboda, is on the steering committee for the NIDIS portal currently under development. Dr. Cody Knutson is also a member of the NIDIS Conceptual Design Committee. As the NIDIS project develops, the researchers will assess how the Republic River watershed portal can be designed to meet the requirement of NIDIS. Similarly, it is important that the portal can be maintained over the long-term with limited state NRD resources. Local NRD partners have expressed a need that the web portal require limited updating and technical expertise to minimize long-term expenses and technical maintenance problems. Therefore, finding a compromise between a high-tech top-down and practical bottom-up approach to the web portal construction is essential.

Besides NRD staff, data on the web portal must also be understandable and useful to a wide range of other local clients such as agricultural producers, municipal water managers, environmental groups, and state and federal land and water managers. Therefore, public

feedback and interactions will be fostered as part of the development process and are described as part of the following section.

## 2. Gather and present contextual information on drought planning efforts and use of climate information

Similar in concept to the work carried out by researchers such as Balstad et al. on climate change research [<http://ccir.ciesin.columbia.edu/nyc/>] and the Southeast Climate Consortium on the use of climate information for reducing agricultural risk [<http://www.agclimate.org>], contextual information on local drought-related research and the use of climate information will be gathered and assessed through a review of the literature and local government websites, as well as through the use of focus groups among local community members and officials.

Specifically, literature and website reviews will be conducted to identify contextual information on historical and current drought planning policies and management efforts within the basin. In addition, a series of focus groups will be held during the first year of the project to gather initial input on the types of information that are available for inclusion in the web portal, the information decision-makers would like to see on the decision-support portal, and their perspectives on how the materials should be presented to ensure a user-friendly product. This will include discussions on the use and non-use of climate and drought information and how products can be tailored to meet the needs of local entities.

It is expected that one focus group will be held in each natural resource district during the first year of the project with assistance provided by staff of the representative NRD. A broad group of stakeholders will be invited including agricultural producers, city water planners, environmental organizations, and state and federal planning agencies from Nebraska, Colorado, and Kansas. Focus groups will follow a semi-structured format with a general list of questions to be asked, but will still allow for an open discussion on the selection of climate and drought monitoring and contextual information to include in the portal and how the information should be presented to most applicable to their needs. This information will be incorporated into the initial design of the web portal. In addition to local user input, suggestions on how to produce relevant climate and drought information from other previous research will also be incorporated into the project (such as, Hartmann and Soroosh (unpublished); Rayner et al. 1998; Jagtap et al. 2002; Ingram et al. 2002; Hanson 2002; Breuer 2005; Hu et al. unpublished; Knutson et al. unpublished).

A similar series of focus groups will also be conducted in year two of the project to assess a more complete version of the portal. Expected interactions will also yield perspectives on future activities that are needed to address gaps in climate and drought information and approaches for drought risk reduction in the watershed. The results of this research will be included on the website and in a final report to NOAA.

## 3. Web Portal Delivery

The web portal will be designed by the National Drought Mitigation Center with input from the three representative NRDs and local citizens within the watershed. The web portal will then be

maintained as part of existing NRD websites. When applicable, the portal may also be incorporated into the National Integrated Drought Information System.

The portal will be advertised and demonstrated through articles in the quarterly NRD newsletters; press releases from the University of Nebraska-Lincoln; letters to the state drought planning committees and entities in Colorado, Kansas, and Nebraska; and included in presentations and relevant workshops delivered by NRD staff and the National Drought Mitigation Center at the local, state, national, and international levels.

## **II. Interactions**

During the Fall of 2007, project collaborators held several conference calls to outline project tasks and timelines and to discuss potential ideas for the development of initial website prototypes. Similarly, project collaborators held additional conference calls through the Spring of 2008 to discuss the development of website prototypes, and to organize a series of four listening and feedback sessions with stakeholders throughout the Republican River Basin that were held from March and May of 2008. These activities are described in more detail in the project accomplishments.

## **III. Accomplishments**

### *A. Tasks Completed*

Several tasks have been completed by May 28, 2008.

1. During the Fall of 2007, a series of conference calls were held between project collaborators to discuss the objectives of the project, the tasks of each collaborator, a final project timeline, and ideas for the development of the drought portal. The collaborators determined the appropriate software that the entities would use in developing the portal, set guidelines for the technical requirements of the portal, and where the website would eventually be housed and who would maintain the website over the long-term.
2. During the Fall of 2007, a review of websites was conducted that could provide information for the portal on: historical drought occurrence, climate monitoring and forecasting, weather and drought impact tracking, watershed and drought planning, educational resources, and past and current water, climate, and drought-related research in the basin.
3. In early 2008, a series of web page mock-ups were designed that could be used to stimulate discussion with stakeholders throughout the basin on how the full website should be developed.
4. A lecture describing the project was presented by the project collaborators to approximately 50 stakeholders from the Republican River Basin in Kansas and Nebraska at the Annual Southwest Nebraska Water Conference in McCook, Nebraska on March 5, 2008. These stakeholders were primarily agricultural producers and natural resource managers. After the introductory lecture, the project collaborators presented initial web page mock-up options of what the home page of the portal could look like and the type of material the website could include. The collaborators then utilized a novel Classroom

Performance System (CPS) to gather feedback on the stakeholder's perspectives of the mock-up options and the type of climate and drought-related information to include on the website. With the CPS system, hand-held remote "clickers" are utilized by the stakeholders to instantaneously register their anonymous response to questions, which are recorded and tallied through a computer system and projected onto a projection screen. This allows stakeholders to immediately see the results of survey questions, which can then be used to foster additional discussion to gain a deeper understanding of their responses. This system was also utilized in later listening and feedback sessions.

5. Based on the initial responses of stakeholders, the project collaborators developed a full mock-up of the drought portal. However, stakeholder responses indicated that they would prefer a website that covered the broader topic of water stress and drought, so the web portal was modified to become the "Republican River Water and Drought Portal" (Figure 1).
6. The mock-up website was then presented again to stakeholders at a series of three listening and feedback sessions within the basin from May 28-30, 2008. The sessions were held in Imperial, Curtis, and Alma, Nebraska. Stakeholders were invited from Kansas, Colorado, and Nebraska in order to gain a broad representation throughout the basin. A total of nearly 60 stakeholders pre-registered for the sessions. At the time of the writing of this report, the first workshop in Imperial had been held with an attendance of 19 stakeholders (e.g., farmers/ranchers, bankers, teachers, NE RAIN weather reporters, and staff from NRCS, Nebraska Game Fish and Parks, and the National Weather Service) who provided a wealth of ideas on how to improve the web portal.



Figure 1. Prototype homepage of the Republican River Water and Drought Portal

## *B. Preliminary Findings*

The initial project research revolved around better understanding the technical resources and capabilities of the collaborating NRDs' organization and staff, in terms of helping to develop and maintain the web portal. There was also a factor of the amount of staff time that the NRDs could devote to the long-term maintenance of the web portal. Although, the NDMC collaborators would assist in developing the website, NRD staff would maintain it over the long-term. Therefore, there were many discussions in regards to appropriate technology and any training needs of the NRD staff. Self-admittedly, the website technical training of the NRDs' staff was modest and any technological tools developed as part of the website would need to reflect their ability to maintain the site and fix any future problems. This is an essential part of the research, since many local management agencies that would model this portal would most likely face similar issues. Therefore, the project collaborators agreed to use a common website development software (Dreamweaver), and that the development of complicated GIS-based databases and other analysis tools may need to be limited.

Additional time was also spent researching the availability of drought, climate, and water-related information in the literature and on the internet that could be used in developing the portal. It was ascertained that there is a great deal of relevant information available, but that it was scattered between many different sources and agencies. Much of this information was then incorporated into the web portal mock-up.

In terms of the development of the mock-ups, stakeholders at the Southwest Nebraska Water Conference provided several guiding perspectives:

1. Stakeholders felt that a portal that reflected the unique nature of the Republican River Basin was preferable to merely copying a more generic template, such as the National Integrated Drought Information System ([drought.gov](http://drought.gov)). They wanted a website that felt "local" and was tailored to their specific informational needs.
2. Stakeholders wanted a portal that focused on more than just drought. They felt that a broader portal that focused on water and drought would be more likely to draw interest and users at times when drought was not occurring, and be more appropriate to get across the idea of long-term watershed planning and drought management.
3. Stakeholders wanted a wide variety of information to be included in the portal: historical water development and drought occurrence; weather and climate monitoring and forecasting; weather and drought impact tracking; watershed and drought planning; water conservation and drought education; and a compilation of water, climate, and drought research going on in the basin.

It was generally felt that the broader focus on water and drought would meet the needs of the NIDIS program, while also addressing other broader management issues in the basin.

Based upon this initial feedback, a full water and drought website mock-up was developed by the project collaborators and presented at listening and feedback sessions in the Republican River Basin from May 28-30. At the time of this report submission (May 28), only the first of the session had been conducted. However, stakeholders at the first session provided a number of ideas on how to improve and expand the web portal. Some of ideas included:

- developing a new “management” section on the portal that outlines specific strategies that stakeholders could take to mitigate drought and water stress (e.g, residue management, deficit irrigation, urban water conservation, etc.)
- develop more products tailored for the Republican River Basin – don’t re-invent the wheel, but look for opportunities to present data at the basin level (e.g., make interactive maps of stream flow stations, ground water monitoring sites, or precipitation monitoring at the basin level).
- include more descriptive text, in some cases, to more fully describe some of the issues presented on the portal – not just links to more information (e.g., a sub-section called “What’s the Deal with Climate Change” that would describe why climate change is important and how it could affect the basin) – don’t overwhelm the site with text, but some issues do require more explanation
- conduct more research and provide information on topics that are especially hard for stakeholder to find and interpret, such as historical drought occurrence and climate change
- develop more case studies and testimonials of how people have been affected by water stress and drought and strategies they’ve implemented to better manage water resources

These and other suggestions identified at the Curtis and Alma, Nebraska, listening and feedback sessions will be considered in developing the next phase of the portal.

### *C. Next Steps in the Project*

Stakeholder suggestions will be assessed and implemented in developing the next phase of the Republican River Water and Drought Portal. Once the general structure and content of the web portal is determined, tasks will then revolve around investigating the potential for developing new visualization and analysis tools for the website, such as GIS-based water, drought, and climate monitoring maps tailored for the basin. The key will be to determine the correct balance of appropriate technology that is useful but also meets the technical requirements of the local natural resources districts. As the portal is being developed, the collaborators will also continually assess the requirements of designing a website that is compatible with the technical requirements for possible integration into the National Integrated Drought Information System.

When the next phase of the web portal is completed in early 2009, another series of stakeholder listening and feedback sessions will again be held throughout the basin. The suggestions gathered during these sessions will be utilized to develop the final product, which will then be included on the websites of the three collaborating NRDs.

### *D. Significant Deviations from Proposed Work Plan*

There have been no significant deviations from the proposed work plan.

#### IV. Impacts/Contributions of Project Results

Thus far, the primary impact and contributions of the project are that the project collaborators have gained insight on the needs and attitudes of stakeholders in the basin in terms of climate, drought, and water-related information through participating in several listening sessions. In addition, the stakeholders participating in the sessions have been exposed to a wide variety of similar information that may help them better understand the climate and water resources of the Republican River Basin, as well as a planning information to help them better manage their limited water resources. The stakeholders have also become engaged in the project, which could lead to future participation in this and other similar projects, including planning projects in the basin to prepare for and deal with current and future climate and water resources variability.

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